PROCESS AND DEVICE FOR INJECTION MOLDING, INJECTION MOLDED PARTS OF PLASTICIZEABLE MATERIAL

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BACKGROUND OF THE INVENTION

The invention relates to a process and device for injection molding of injection molded parts from plasticizeable material, with a first plasticizeable material being injected into an injection mold and hardening on the edge of the mold and subsequently a second plasticizeable material which differs from the first one is injected into the injection mold.

Such processes are known as "sandwich process" or "mono-sandwich process", and lead in the injection molded parts to an outer envelope and a core, whereby envelope and core are, preferably, made of different materials. The strength of such materials is impacted by the selection of the used materials and their strength.

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SUMMARY OF THE INVENTION

The invention is based on the object to increase the strength of the injection molded parts made by known processes.

This object is attained by moving only the second plasticized material during solidification.

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Movement of the material lead, on the one hand, to an increased strength, and, on the other hand, to a good bond between the first and second materials. It

will be understood in this context that the first and second materials may also be selected identical except for the applied temperature and other parameter. The invention permits manufacture of injection molded parts with completely new and novel properties.

Advantageously, the second plasticized material is injected through at least a second opening into the injection mold. Injection of material from both sides has the advantage that the plungers or screws used for injection of the materials can be timed relative to one-another so that a movement is generated in the second plasticized material

Such a plunger arrangement also permits to move the second plasticized material in only one direction. A movement of the second plasticized material in one direction may also be implemented by means of a plunger and an overflow opening in the injection mold. So long as the injection mold has two openings, these openings may also be interconnected by a bypass so that the second plasticized material can circulate by using a suitable valve technique. The movement may, on the one hand, be generated by feed screws or feed plungers. On the other hand, it is also possible to provide a pump in the bypass.

In accordance with a preferred embodiment, the movement is generated through oscillation of the injection plunger or injection plungers. The oscillation does not cause a strong mass shift and has the advantage that the plasticized

material is aligned.

According to a variation, the movement is generated through ultrasonic. A movement in the injection mold can be generated even with ultrasonic for movement of solely the second plasticized material.

According to a further variation, an electromagnetic field acts upon the second plasticized material. Also in this way, the plasticized material is aligned.

In special fields of application, it is possible to generate the movement through injection of a fluid. The term "fluid" will denote, on the one hand, a gas, and, on the other hand, any liquid which is injected into the second plasticized material. Hereby, the fluid is utilized to push or shove the material. Hereby, the fluid can be used to generate one or more hollows in the injection mold. At the same time, the fluid remains advantageously inert during these events, and thus reacts only insignificantly with the melt.

According to a further variation, the movement is generated through a melt pump. For example, a gear pump which is used instead of a plunger, may generate a movement in one direction or a to-and-fro movement.

According to an exemplified embodiment of the invention, the second plasticized material is injected from two locations, at least partially

simultaneously, into the injection mold. Then, the material impacts on one location to produce there a seam which can or is especially hardened by the movement. This seam zone results in a particularly high strength, and it is proposed to position this seam zone in particularly stressed regions. The seam zone, which heretofore was positioned in less stressed regions as a consequence of its slight strength, has a strength increased by about factor 4 because of the movement of the plasticized material during solidification. This advantage is not only limited to the sandwich-process but can be utilized in general in injection molding processes.

For example, incorporation of electronic circuits in an injection molded part can be realized by placing a sheet or a reinforcement fabric into the injection mold before or after injection of the first plasticized material. The sheet may include an electronic circuit, and the reinforcement fabric may be used to increase the strength. The inserted sheet may be made of different materials. A decorating sheet serves visual purposes. The sheet may, however, have particular chemical and/or physical and/or electric and/or thermal and/or optical and/or mechanical properties, as dictated by the particular application. A broad field of application includes sheets which include electric or electronic circuits generated in a photo-optical or galvanic manner. Reinforcement fabrics may include especially glass fiber fabrics, carbon fiber fabrics and/or an inherent fiber fabric whereby the inherent fiber fabric includes fibers of a material contained in the first plasticized material and/or the second plasticized material. The use of

such reinforcement fabrics or sheets is also advantageous per se in order to realize, on the one hand, desired properties such as look, strength or conductivity, and, on the other hand, high production rates during injection molding.

Hereby, in particular the inherent fiber fabric can be incorporated already aligned. Moreover, the process can be operated such that initially liquid melt is introduced for penetration of the fabric. Subsequently, the second material, for example a melt permeated with inherent fibers, can be introduced and, optionally, moved in accordance with the invention. In this way, a seam can be reinforced in a desired fashion.

The above-described application may also be used together with the above-described utilization of a fluid.

In accordance with a variation of the process, which is advantageous in many cases, the first material covers only a part of the wall surface of the injection mold. Thus, the injection mold has an outer wall of two different materials which may exhibit different colors. In this process, a shoulder in the mold is advantageously utilized to realize a defined transition between both materials.

According to an alternative, after partially filling the injection mold with a first material, a further area of the injection mold is opened by means of a slide gate and subsequently filled with the second material. Also the slide gate results in a defined transition of the first to the second material. Preferably, the slide gate is activated in dependence on the injection process - i.e. for example, the distance traveled by a feed screw, the time needed for the injection phase, or a pressure applied at the injection device or in the mold.

According to a modification of the process according to the invention, at least a further plasticized material is injected before the first plasticized material. This results in a structure of the injection molded part of individual concentric layers, whereby depending on the process course, the plasticized material of certain layers can be moved. Moved and immobile layers may alternate, or it is also possible to introduce moving layers in sequence in the form of a layer cake to produce a particularly firm injection molded part.

It is advantageous to provide the second plasticized material with a filler. Examples of fillers include fibers, particles, soot and metals. Examples of plasticized material include besides plastics also plasticizeable ceramics and plasticizeable powdered metal.

Injection molded parts made according to the described process are suitable in view of their high strength as stabilizers, as strut shaft or cardan shaft

and as reinforcement sleeve (insert) for most different purposes. The parts are superior to absorb loads in particular tensile pressure as well as bending stress. The use of different materials, especially as first plasticized material, permits the production of lids or casings with seal, running rollers with hub and running surface, vibration damper footing, shock absorbers, coolant pipes with hard and soft zones, filter elements, clutch pedals or other pedals.

In particular the use of thermoplastic rubber as plasticizeable material enables the manufacture of hinges, whereby two or more solid plastic materials can be interconnected by a rubber piece. According to a preferred exemplified embodiment, harder thermoplastic materials are injected from both sides as first plasticized material to form two spaced-apart bodies. Subsequently, the distance between the bodies, and, optionally, an inner side, is filled with rubber material so that a hinge is realized between two plastic parts.

To attain the object, also an injection molding device with an adjustment nozzle can be used.

Practice has shown that the positioning of the adjustment nozzle between injection mold and injection molding device is oftentimes very time-consuming. This object is attained by positioning the adjustment nozzle of a typical injection molding device upon a surface and securing the adjustment nozzle with a flange.

Normally, the adjustment nozzle is threadably engaged in the surface of the injection molding device and during screwed attachment of the adjustment nozzle the distance of the nozzle end varies with respect to the injection molding device. This problem is eliminated by fixedly securing a flange, mounted to the adjustment nozzle, or a flange, placed over the adjustment nozzle, to the injection molding device, so that the adjustment nozzle can be affixed to the injection molding device in any position rotated about its axis. The described device is especially advantageous, in particular when the adjustment nozzle has several openings, which should be utilized alternately.

According to a further feature of the described device, the adjustment nozzle has different channels and is movable in a block, so that a channel of the adjustment nozzle is aligned with a channel in the block.

This hot runner block according to the invention, either permits to direct material plasticized by the adjustment nozzle through the hot runner block to the injection mold or to an extruder, or to terminate the introduction at a wall surface of the block and to implement a throughflow of the block from this extruder via a further channel of the adjustment nozzle. Also, different extruders may be operatively connected in this manner with an injection opening of the injection mold.

Preferably, the injection mold is tempered with a metal alloy of low melting point.

To attain the object also an adjustment nozzle can be used for an injection molding device with two interconnected outlets, each of which is provided with a check valve, with the check valves working in opposite direction. Also conceivable are nozzles with several channels, whereby in this case, at least one of the nozzles should include a valve, preferably a check valve. Otherwise, the check valves can be chosen to suit the situation.

Preferably, the injection mold is tempered with a metal alloy of low melting point. In this manner, a quick mold tempering (dynamic) can be realized. In particular, the use of such a metal alloy is suitable for thinwalled regions to thereby permit manufacture of fairly complex injection molded parts of very high quality. The use of a metal alloy with low melting point is advantageous regardless of the other above-stated features for tempering an injection mold.

a BRIEF DESCRIPTION OF THE DRAWINGS

A device for carrying out the process according to the invention will be explained in more detail below and is shown, by way of example, in the drawing, in which:

FIG. 1 is a schematic illustration of an injection molding device for the process according to the invention;

FIG. 2 shows the securement of an adjustment nozzle to an injection molding device;

FIG. 3 is a schematic illustration for circulation through an injection molding device;

FIG. 4 is a perspective illustration of a hot runner block with adjustment nozzle; and

FIG. 5 is a sectional view through the adjustment nozzle according to FIG. 4.

a DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

The injection molding device 1 shown in FIG. 1 includes an injection mold 2 with a mold cavity 3 having two openings 4 and 5. These openings 4 and 5 are each connected via branching conduits 6 and 7 with two feed assemblies 8, 9 and 10, 11 for plasticized material. The branching T-pieces 14, 15 permit alternating connection of a respective one of the feed assemblies 8 or 9, and 10 or 11 with the mold cavity 3.

Thereby, it is possible to feed plasticized material from two sides into the mold cavity 3 from the feed aggregates 8 and 11 and subsequently to direct another plasticized material through the feed assemblies 9 and 10 into the mold cavity 3.

Furthermore, plasticized material can be pushed initially from the feed assemblies 9 and 10 into the feed assemblies 8 and 11 and subsequently layered material is first pushed from one of the feed assemblies 8 into the mold cavity and then layered material is pushed from the other assembly 11 into the mold cavity, thereby realizing a quadruple layer arrangement in the mold cavity.

Furthermore, material introduced into the mold cavity 3 via one opening 4 can overflow, and overflow through the further opening 5 in another feed aggregate, or it may be pushed into a bypass 12. Furthermore, the pump 13 permits a circulating flow in the bypass12 through the mold cavity 3.

Depending on the valve position at locations 14 and 15, the above-described processes can thus be realized.

FIG. 2 shows an adjustment nozzle 20 which has a flange for threaded engagement to an injection molding device 22. A stepped shoulder 23 on the adjustment nozzle 20 provides a precise fit of the adjustment nozzle 20 in an oppositely stepped shoulder 24 on the injection molding device 22. After placement of the adjustment nozzle 20 onto the injection molding device 22, the flange 21 is placed over the adjustment nozzle and screwed to the injection molding device 22 for securing the adjustment nozzle.

Sub B The adjustment nozzle 20 has an inlet on the side of the injection molding

device 22 as well as two outlets 30, 31 and 30', 31' on the mold side. Provided within the adjustment nozzle 20 are check valves 25, 26, and 25', 26' operating in opposite directions.

FIG. 3 shows one option to use such an adjustment nozzle. This allows to circulate the mold part 27 either in direction of the arrow 28 or in direction of the arrow 29. In this manner, layers of different alignment can be realized without any problems. It will be understood that also other flow paths through such a nozzle 20 can be implemented.

FIG. 4 shows a hot runner block 30 which interacts with a particular adjustment nozzle 31. The hot runner block has a through channel 32 and a central round opening 33 which intersects the channel 32 for receiving the nozzle head of the adjustment nozzle 31. This nozzle head has a bore 34 which extends transversely to the axis of the adjustment nozzle, with the bore corresponding to the diameter of the channel 32 and aligned with the channel 32 through counterboring the adjustment nozzle in the opening 33 of the hot runner block 30.

Above the bore 34, the adjustment nozzle 31 is provided with a L-shaped bore 35 which should also be aligned with the channel 32 and then connects the adjustment nozzle body 36 with the channel 32 to convey plasticizeable material from the adjustment nozzle body 36 through the L-shaped channel 35 into the channel 32.

The channel 32 is further connected by a feeder 37 with the mold cavity 3.

On the other hand, the adjustment nozzle may also be used in the other direction so that the L-shaped channel 34 can convey melt from one secondary extruder to a main extruder from which the melt can be returned through the channel 35 into the channel 32 and into the mold cavity 3.

The above-described nozzles 20 and 30 ensure a particularly simple implementation of the above-described processes in view of their compact structure and can easily be placed, instead of existing single-pass nozzles, upon injection molding devices, such as extruders or plunger-type injection molding devices, so that the latter can be retrofitted without any complex structural modifications for application of the process according to the invention.

Thus, the adjustment nozzles 20 and 30 permit the use of different flow paths simply by controlling the injection molding device.